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# Diversity of Butterflies in Tamil Nadu Agriculture College and Research Institute Campus, Madurai, Tamil Nadu, India

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**Abstract:** *Butterflies form an important group of insects and offer many ecosystem services. Their survival and diversity is influenced by several factors including habitat destruction and climate change. Hence the present study aims at monitoring the diversity of butterflies in Tamil Nadu Agriculture College and Research Institute campus from July 2015 to April 2016. Monthly transect counts were carried out in selected locations and the Biodiversity indices were calculated using formulae. Totally 52 species of butterflies belonging to four families were recorded. Biodiversity indices exhibited variations with reference to months and the results are discussed.*

**Keywords:** *Butterflies, Biodiversity, Species richness, Shannon-Weaver index, Simpson index.*

## INTRODUCTION

Insects comprise more than half of earth's diversity of species. Butterflies are the attractive and elegant insects which offer more economical and ecological benefits to the human beings. They enhance the earth's beauty incontestably and add immense aesthetic value to the ambient environment through their external appearance. They accomplish pollination, a key stone ecological process in natural sustainability throughout the world (Merlin and Liedvogel, 2019; Ullah *et al.*, 2017). Butterflies pollinate more than fifty economically important crops. Being dependent on vegetation both as adults and larvae, they involve themselves in complex feeding relationship with green plants. As adults they require accession of adequate nectar resource. Nectar provides energy for flight, which is vital to find mates and to disperse the species. Larvae of butterflies are typically host specific and often show a "Botanical instinct" in closely related plants (Kakehashi *et al.*, 2018; Lewington, 2016; Joshi *et al.*, 2017).

Most of the insects are acting as bioindicators which are highly sensitive to changes in temperature, humidity, light, rainfall patterns and other climatic conditions in the environment. They have distinctive constraints for their behavioural activities in various habitats. As such butterflies serve as the best rapid indicators of habitat quality and also they are the sensitive indicators of climatic change. They have been studied systematically, since the early 18<sup>th</sup> century and about 19,238 species are documented worldwide. There are about 1,504 species of butterflies in Indian subcontinent. 334 species of butterflies were reported from the Western Ghats and 150 from the Eastern Ghats. The number of Indian butterflies amounts to one fifth of the world species (Naik and Mustak, 2016; Nitin *et al.*, 2018; Ramírez-Restrepo and MacGregor-Fors,

2017; Karmakar et al., 2018). Several studies have been carried out with relevance to the species composition, richness, diversity and distribution of butterflies in different parts of the world. The distribution of butterflies depends upon the availability of their host plants. In this context, the present work has been undertaken to study the diversity of butterflies in the Tamil Nadu Agriculture College & Research Institute Campus in Madurai.

## **Materials and Methods**

### **Study Area**

The present study was conducted from July 2015 to April 2016 at Tamil Nadu Agriculture College & Research Institute Campus in Madurai. This site is located ten kilometers away from Madurai city. The sampling was done in four regions of the study area namely, Main gate, Dean's bungalow, Main hall and Dairy farm during the study period.

### **Monitoring and Recording**

In order to evaluate habitat enrichment, regular monitoring of the butterflies was carried out by making transect counts and recording their number for the entire study period from July 2015 to April 2016. A visual survey was done during each sampling period. The butterflies were identified based on wing structure and the date of observation, number of species and individuals were recorded in the four locations. The butterflies were enumerated from 9.00am to 12.00noon every month. Some species which were difficult to identify, were caught by hand net and released after identification. Mostly photographs were taken and species identification was done using various field guides and other available literature (Kunte, 2000; Mukherjee *et al.*, 2015; Glassberg *et al.*, 2000; Glassberg 2001).

### **Data Analysis**

Species richness and diversity indices such as Shannon-Weiner and Simpson's Index were calculated to find out the species diversity.

#### **Species Richness**

Species richness is the determination of number of species present in the sample. Increase of sample size enhances the possibility of observing more species. This kind of estimation of species richness is called as D, the Menhinick's index (Menhinick, 1964) which is calculated by the following formula.

$$D = s / \sqrt{N}$$

Where, s = the number of different species represented in sample; N = the total number of individual organisms in sample.

#### **Shannon's Diversity Indices**

Shannon's Diversity Index (Shannon and Wiener, 1998) assumes that individuals are randomly sampled from an independent large population and all the species are represented in the sample. It can be used for comparing diversity between different habitats. It was calculated using the following formula

$$H' = - [\sum P_i \ln P_i]$$

Where, H' = Diversity Index; P<sub>i</sub> = the proportion of each species in the sample; lnP<sub>i</sub> = natural logarithm of this proportion. From this, Shannon's Equitability Index was calculated using the formula

$$\text{Shannon's Equitability Index} = H/H_{\text{Max}}$$

#### **Simpson's Indices**

Simpson's indices (Simpson, 1949) measure the probability that two individuals randomly selected from a sample will belong to the same species. It has been measured by the formula

$$D = 1 - \left\{ \sum n(n-1) / N(N-1) \right\}$$

Where, n = the total number of butterflies of a particular species; N= the total number of butterflies of all species. From D value, 1-D and 1/D values were calculated.

## Results and Discussion

Pollinators play an important role in the ecosystem. It is necessary to identify the environmental factors affecting pollinator populations and how one can prevent these environmental problems in the community (Bommarco *et al.*, 2012). The composition and diversity pattern of butterfly species in Tamil Nadu Agriculture College and Research Institute Campus, Madurai, Tamil Nadu, India was analysed. Total number of fifty two species of butterflies belonging to four families namely, Nymphalidae, Pieridae Lycaenidae and Papilionidae were observed from the study area from July 2015 to April 2016 (Fig.1). Nymphalidae (24 species) was found to be a more prevalent family in all the four locations of the present study when compared with other families such as Pieridae (15 species), Lycaenidae (7 species) and Papilionidae (6 species). Similar kinds of observations were also noticed by different researchers in various study areas (Tiple, 2012; Majumder *et al.*, 2012; Prabakaran *et al.*, 2014).

Diversity index is a mathematical measure of species diversity in a community. Indices provide more information about community composition by taking relative abundances of different species into account. They provide important information on rarity and commonness of species in a community. They help to quantify diversity and serve as important tools to understand community structure (Spellerberg and Fedor, 2003). Based on the data analysis, Richness, Shannon-Weaver, and Simpson's index values were calculated and exhibited (Table 1, 2 and 3). With reference to richness index, maximum value was observed in March and April, 2016 while the minimum was noticed in July, 2015. From this it can be inferred that the diversity was more during the summer months. The diversity increased towards rainfall and winter season.

Shannon diversity index (H) is used to characterize species diversity in a community. It accounts for both abundance and evenness of the species present. In the present study, Shannon's diversity index was minimum in September 2015 and maximum in February 2016. Shannon's equality index value was the minimum during September 2015 and the maximum in April 2016. The minimum was during rainfall while the maximum was in summer season during the present study.  $H/H_{max}$  - Shannon's equitability index assumes a value between 0 and 1 with 1 being the complete evenness. Diversity and evenness are more in undisturbed habitat. Shannon's index values are often found to fall from 1.5 to 3.5. This index becomes useful only while comparing two or more sites. In Simpson's index, the value of D ranges between 0 and 1. Zero represents infinite diversity and 1 represents no diversity. Bigger the value of D, the lower is the diversity. Simpson's index of diversity (1-D) was the maximum in September, 2015 and the minimum during August, 2015. Simpson's index of diversity represents the probability that two individuals randomly selected from a community will belong to different species. The value ranges between 0 and 1. The greater the value, the greater is the diversity. With reference to Simpson's reciprocal index (1/D), the maximum was in August, 2015 and the minimum in September, 2015. It starts with 1 as the lowest possible figure. The higher the value, the greater would be the diversity. Simpson's index is of limited value in conservation biology if an area has many more rare species with just one individual (Bibi and Ali, 2013).

The Diversity (diversity index, species richness and evenness) of butterflies in the study area is mainly due to the rich vegetation in this area as vegetation plays an important role for the existence of insect fauna in a community as it provides the main source of food and shelter for insects. Conservation of the natural habitats is very essential for the existence of many species of Lepidoptera. The survival of a large number of endemic species in a community or habitat warrants frequent monitoring of the ecological processes besides adoption of appropriate conservation strategies in order to safeguard its rich genetic diversity (Forister *et al.*, 2010; Bartel *et al.*, 2010; Majumder *et al.*, 2013). The present work was an attempt to describe some aspects of

biodiversity of butterflies at Tamil Nadu Agriculture College and Research Institute Campus, Madurai, Tamil Nadu, India. Further studies relevant to the present work are very much useful for getting a detailed periodic estimate of the diversity of butterflies in this area. Ultimately it is hoped that such work may lead to the development of standard monitoring procedures which could be of value in assessing the environmental stability of areas under cultivation for different crops and the prediction of the effect of tropical forest destruction on butterfly populations.

### Conclusion

Totally 52 species of butterflies belonging to four families of the Order Lepidoptera were recorded during the study period in the campus. The diversity was rich during summer months.

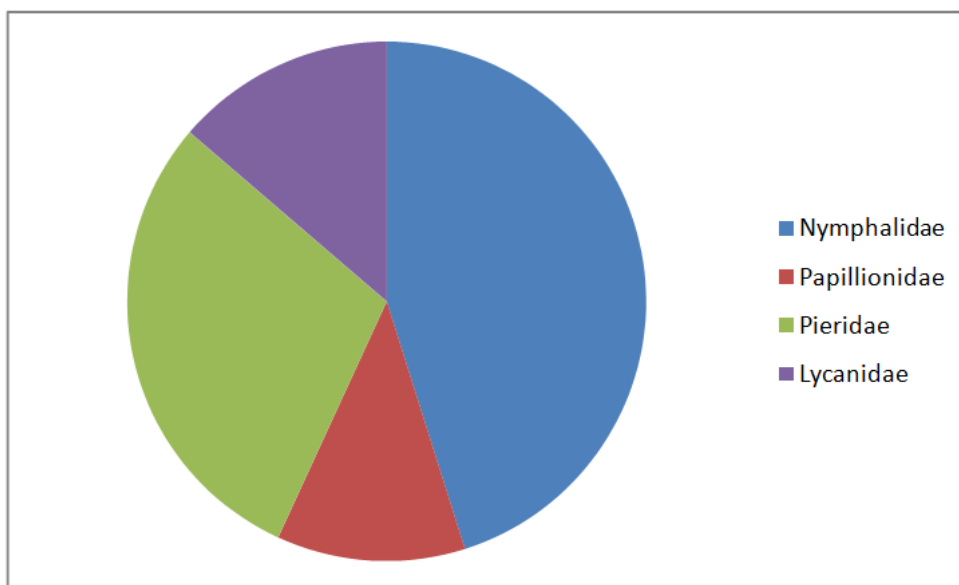
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**Figure 1.** Butterflies observed in Tamil Nadu Agriculture College and Research Institute, Madurai from July 2015 to April 2016.

**Table 1.** Species Richness index calculated for butterflies observed from July 2015 to April 2016.

S.No	Month	Richness
1	July-2015	19.8
2	August	27.6
3	September	33
4	October	38
5	November	42
6	December	44.2
7	January-2016	46.2
8	February	49.2
9	March	51
10	April	51

**Table 2.** Shannon’s Diversity Indices calculated for Butterflies observed from July 2015 to April 2016

S.No	Month	Shannon’s Diversity Index	Shannon H Max	Shannon’s Equitability Index
1	July- 2015	0.919	1.255	0.732
2	August	1.156	1.342	0.861
3	September	0.686	1.204	0.57
4	October	0.792	1.255	0.631
5	November	0.914	1.38	0.662
6	December	1.009	1.38	0.731

7	January- 2016	1.114	1.322	0.842
8	February	1.165	1.38	0.842
9	March	1.126	1.322	0.852
10	April	1.065	1.23	0.866

**Table 3.** Simpson’s indices calculated for butterflies observed from July 2015 to April 2016.

S.No	Month	Simpson’s Index of Diversity (1-D)	Simpson’s Reciprocal Index (1/D)
1	July-2015	0.185	5.405
2	August	0.089	11.175
3	September	0.345	2.902
4	October	0.275	3.638
5	November	0.227	4.517
6	December	0.154	6.507
7	January -2016	0.122	8.225
8	February	0.094	10.663
9	March	0.095	10.475
10	April	0.097	10.332